PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P19208WO1	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/SE2005/000108	International filing date *(day/month/year)* 28.01.2005	Priority date *(day/month/year)* 28.01.2004

International Patent Classification (IPC) or national classification and IPC

See Supplemental Box

Applicant

Telefonaktiebolaget LM Ericsson (publ) et al

1.   This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2.   This REPORT consists of a total of **4** sheets, including this cover sheet.

3.   This report is also accompanied by ANNEXES, comprising:

    a.   ☒   *(sent to the applicant and to the International Bureau)* a total of **13** sheets, as follows:

         ☒   sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).

         ☐   sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

    b.   ☐   *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))

         _____ , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4.   This report contains indications relating to the following items:

     ☒   Box No. I   Basis of the report

     ☐   Box No. II   Priority

     ☐   Box No. III   Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

     ☐   Box No. IV   Lack of unity of invention

     ☒   Box No. V   Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

     ☐   Box No. VI   Certain documents cited

     ☐   Box No. VII   Certain defects in the international application

     ☐   Box No. VIII   Certain observations on the international application

Date of submission of the demand 26-08-2005	Date of completion of this report 04-05-2006
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Form PCT/IPEA/409 (cover sheet) (April 2005)

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Cover sheet

International patent classification (IPC)

H04Q 7/38 (2006.01)
H04Q 7/22 (2006.01)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2005/000108

Box No. I	Basis of the report

1. With regard to the **language**, this report is based on:

    ☐ the international application in the language in which it was filed

    ☐ a translation of the international application into _____ ,
    which is the language of a translation furnished for the purposes of:

    ☐ international search (Rules 12.3(a) and 23.1(b))

    ☐ publication of the international application (Rule 12.4(a))

    ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

    ☐ the international application as originally filed/furnished

    ☒ the description:

    pages ___1-24_____ as originally filed/furnished

    pages* _____ received by this Authority on _____

    pages* _____ received by this Authority on _____

    ☒ the claims:

    _____ as originally filed/furnished
    pages _____
    pages* _____ as amended (together with any statement) under Article 19
    pages* ___25-37_____ received by this Authority on ___29-08-2005_____
    pages* _____ received by this Authority on _____

    ☒ the drawings:

    pages ___1-4_____ as originally filed/furnished

    pages* _____ received by this Authority on _____

    pages* _____ received by this Authority on _____

    ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

    ☐ the description, pages _____

    ☐ the claims, Nos. _____

    ☐ the drawings, sheets/figs _____

    ☐ the sequence listing *(specify)*: _____

    ☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

    ☐ the description, pages _____

    ☐ the claims, Nos. _____

    ☐ the drawings, sheets/figs _____

    ☐ the sequence listing *(specify)*: _____

    ☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

Form PCT/IPEA/409 (Box No. I) (April 2005)

Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

			YES
Novelty (N)	Claims	1-80	
	Claims		NO

			YES
Inventive step (IS)	Claims	1-80	
	Claims		NO

			YES
Industrial applicability (IA)	Claims	1-80	
	Claims		NO

2. Citations and explanations (Rule 70.7)

The object of the invention concerns a method and an apparatus for a lossless packet-switched handover in a LCC unacknowledged mode. The invention aims to solve the problem that packets may be lost during the handover.

The following documents are cited in the International Search Report:

D1: Digital cellular telecommunications system (Phase 2+); Mobile Station - Serving GPRS Support Node (MS-SGSN); Subnetwork Dependent Convergence Protocol (SNDCP) (3GPP TS 44.065 version 5.1.0 Release 5), September 2003.
D2: EP 0891114 A1
D3: WO 03107693 A1
D4: WO 0217651 A1
D5: US 20030169725 A1
D6: US 20010043579 A1

The documents cited in the International Search Report represent the prior art. The claimed invention stated in claims 1-80 is not considered to be anticipated by these documents. None of the documents, or any relevant combination of them, reveals a method, mobile station, support node, base station and a communication system for a lossless packet-switched handover in a LCC unacknowledged mode as described by these claims.

According to the arguments stated above, the invention claimed in claims 1-80 is novel, considered to involve an inventive step and to have industrial applicability.

CLAIMS

1. A method of base station change, the base station transferring packet switched communications between a mobile station and a support node, the method c h a r a c -
t e r i z e d i n that the base station change is of
5 lossless type allowing lossless base station change of packet switched communications in unacknowledged mode between the mobile station and the support node, the support node acting as source support node during the base station change forwarding maintained sequence number information to
10 a target support node of the base station change when the source and target support nodes are different.

2. The method according to claim 1 c h a r a c t e r - i z e d i n that a protocol entity maintains N-PDU send and receive sequence numbers, and GTP T-PDU uplink and
15 downlink sequence numbers for each packet flow subject to base station change of lossless type, the support node acting as source support node during the base station change, forwarding maintained sequence number information to a target support node of the base station change.

20 3. The method according to claim 2 c h a r a c t e r - i z e d i n that downlink N-PDU and downlink GTP T-PDU sequence numbers are provided along with each N-PDU forwarded from the source support node to the target support node.

25 4. The method according to claim 2 c h a r a c t e r - i z e d i n that LLC data buffered in source BSS that has not been sent to, or acknowledged by, the mobile station at the point in time when the source BSS sends the PS handover command message to the mobile station is deleted.

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5.   The method according to claim 4 c h a r a c t e r - i z e d   i n   that a status message is sent back to the source support node telling it how many LLC PDUs have been deteted.

5   6.   The method according to claim 5 c h a r a c t e r - i z e d   i n   that the status message provides part of the one or more deleted LLC PDUs.

7.   The method according to claim 6 c h a r a c t e r - i z e d   i n   that the status message provides the header

10   of the one or more deleted LLC PDUs.

8.   The method according to claim 2 c h a r a c t e r - i z e d   i n   that a set of N-PDUs sent down to the source BSS are buffered in the support node for each packet flow subject to lossless PS handover.

15   9.   The method according to claim 2 c h a r a c t e r - i z e d   i n   that a PS handover command message contains an RLC ACK/NACK report allowing a mobile station to determine which one or more N-PDUs have been completely received by the network.

20   10.   The method according to claim 2 c h a r a c t e r - i z e d   i n   that a mobile station starts uplink transmission upon handover to a target cell, by an estimated next uplink N-PDU that was not acknowledged by lower layers in a source cell from which the mobile station

25   was handed over to the target cell.

11.   The method according to claim 2 c h a r a c t e r - i z e d   i n   that a PS handover command sent from the support node to a source BSS includes expected Receive N-PDU sequence number, at which a mobile station should start

30   transmission in a target cell for each uplink packet flow subject to lossless handover.

AMENDED SHEET

12. The method according to claim 2 c h a r a c t e r - i z e d   i n that a mobile station buffers one or more uplink N-PDUs which have been confirmed according to RLC.

13. The method according to claim 2 c h a r a c t e r - i z e d   i n that uplink and downlink G-PDU sequence numbers associated with uplink and downlink N-PDUs are recorded while in unacknowledged mode between the mobile station and the support node.

14. The method according to claim 1 c h a r a c t e r - i z e d   i n that the base station change allows an entire data transfer session in unacknowledged mode.

15. The method according to claim 14 c h a r a c t e r - i z e d   i n that the data transfer session is a session of data file transfer.

16. The method according to claim 1 c h a r a c t e r - i z e d   i n that the packet switched communications in unacknowledged mode between the mobile station and the support node concerns unacknowledged mode of LLC protocol.

17. The method according to claim 1 comprising a mode of operation c h a r a c t e r i z e d   b y recording one or more sequence numbers of one or more protocol data units in both uplink and downlink.

18. The method according to claim 17 c h a r a c t e r - i z e d   i n that the protocol data units are N-PDUs.

19. The method according to claim 17 c h a r a c t e r - i z e d   i n that the protocol data units are G-PDUs.

20. The method according to claim 1 c h a r a c t e r - i z e d   i n that SNDCP sequence continuity is maintained

across a support node involved in packet switched base station change.

21. The method according to claim 1 c h a r a c t e r - i z e d i n that one or more SN-UNITDATA protocol data unit includes one or more N-PDU.

22. The method according to claim 21 c h a r a c t e r - i z e d i n that N-PDU number is included in a header of SN-UNITDATA protocol data unit.

23. The method according to claim 1 c h a r a c t e r - i z e d i n that a support node connected to a source base station or base station subsystem to be changed in- forms a mobile station, also connected to the base station or base station subsystem, on a next expected uplink proto- col data unit to be received.

24. The method according to claim 1 c h a r a c t e r - i z e d i n that a mobile station connected to a source base station or base station subsystem to be changed in- forms a source support node, also connected to the base station or base station subsystem, on a next expected down- link protocol data unit to be received.

25. The method according to claim 23 or 24 c h a r a c - t e r i z e d i n that the base station or base station subsystem relays the information between mobile station and support node with no required processing of the information.

26. The method according to any of claims 23-25 c h a r - a c t e r i z e d i n that the source base station or base station subsystem is allowed to continue receiving uplink data while emptying downlink buffers as a response to a PS Handover Command.

27. The method according to any of claims 1-26 c h a r -
a c t e r i z e d i n that the protocol data units are
compliant with Sub-Network Dependent Convergence Protocol.

28. The method according to claim 27 c h a r a c t e r -
5 i z e d i n that SNDCP entities in a source support node
buffers one or more downlink N-PDUs.

29. The method according to claim 28 c h a r a c t e r -
i z e d i n that the source support node buffers a number
of N-PDUs corresponding to the delay attribute of the asso-
10 ciated packet flow.

30. The method according to claim 29 c h a r a c t e r -
i z e d i n that the buffered N-PDUs are forwarded to a
target support node during the base station change.

31. The method according to claim 30 c h a r a c t e r -
15 i z e d i n that the received forwarded N-PDUs in target
support node are forwarded to the mobile station.

32. The method according to claim 31 c h a r a c t e r -
i z e d i n that the one or more N-PDUs are forwarded to
the mobile station when the support node has received a PS
20 Handover Complete message.

33. The method according to claim 27 c h a r a c t e r -
i z e d i n that one or more downlink N-PDUs are buffered
in SNDCP entities in a target support node.

34. The method according to claim 33 c h a r a c t e r -
25 i z e d i n that the target support node buffers a number
of uplink N-PDUs corresponding to the number of N-PDUs
received from the source support node.

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35. The method according to claim 27 c h a r a c t e r - i z e d   i n   that one or more uplink N-PDUs are buffered in SNDCP entities in a mobile station.

36. The method according to claim 35 c h a r a c t e r - i z e d   i n   that the mobile station buffers a number of N-PDUs corresponding to the maximum delay of RLC/MAC ac-knowledgement of transmission of LLC PDU.

37. A mobile station for packet switched communications communicating over a communications network including base stations and one or more support nodes, the mobile station c h a r a c t e r i z e d   b y   processing means operating according to one or more protocols receiving protocol data units, the processing means extracting information for the mobile station to inform the network of next expected down-link protocol data unit in association with packet switched base station change allowing lossless base station change of packet switched communications in unacknowledged mode.

38. A mobile station for packet switched communications communicating over a communications network including base stations and one or more support nodes, the mobile station c h a r a c t e r i z e d   b y   processing means operating according to one or more protocols transferring protocol data units and receiver receiving informing from the net-work on next expected uplink protocol data unit in associa-tion with packet switched base station change allowing lossless base station change of packet switched communica-tions in unacknowledged mode.

39. The mobile station according to claim 37 or 38 c h a r a c t e r i z e d   i n   that the protocol data units are compliant with Sub-Network Dependent Convergence Protocol.

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40. The mobile station according to claim 39 c h a r - a c t e r i z e d b y a buffer for buffering one or more uplink N-PDUs which have been confirmed according to RLC.

41. The mobile station according to claim 40 c h a r - a c t e r i z e d i n that the mobile station starts uplink transmission upon handover to a target cell, by transmitting an estimated next uplink N-PDU that was not acknowledged by lower layers in a source cell from which the mobile station was handed over to the target cell.

42. The mobile station according to claim 41 c h a r - a c t e r i z e d b y the processing means recording according to the Sub-Network Dependent Convergence Protocol N-PDU sequence numbers of N-PDUs received or transferred.

43. The mobile station according to claim 39 or 40 c h a r a c t e r i z e d b y protocol data units including N-PDUs.

44. The mobile station according to any of claims 41-43 c h a r a c t e r i z e d b y buffer means, buffering uplink N-PDUs

45. The mobile station according to claim 44 c h a r - a c t e r i z e d i n that the buffer size is sufficiently large for a number of N-PDUs corresponding to the maximum delay of RLC/MAC acknowledgement of transmission of LLC PDU to be buffered.

46. The mobile station according to any of claims 39-43 c h a r a c t e r i z e d i n that the information on next expected protocol data unit is transferred in a message initiating or completing a change of base station or handover as regards the mobile station.

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47. The mobile station according to claim 46 c h a r - a c t e r i z e d i n that the message initiating or completing a change of base station or handover is a PS Handover Command or PS Handover Complete message.

5   48. A support node in a packet switched communications network comprising base stations for communications involving at least one mobile station, the support node c h a r a c t e r i z e d b y processing means operating according to one or more protocols receiving protocol data

10   units, the processing means extracting information for the support node to inform a mobile station of next expected uplink protocol data unit in association with packet switched base station change in unacknowledged mode of the at least one mobile station.

15   49. A support node in a packet switched communications network comprising base stations for communications involving at least one mobile station, the support node c h a r a c t e r i z e d b y processing means operating according to one or more protocols transferring protocol

20   data units and receiver receiving informing from the at least one mobile station on next expected downlink protocol data unit in association with packet switched handover allowing lossless base station change in unacknowledged mode of packet switched communications.

25   50. The support node according to claim 49 c h a r a c - t e r i z e d b y a protocol entity for maintaing N-PDU send and receive sequence numbers, and GTP T-PDU uplink and downlink sequence numbers for each packet flow subject to base station change of lossless type, the support node

30   acting as source support node during the base station change, forwarding maintained sequence number information to a target support node of the base station change.

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51. The support node according to claim 50 c h a r a c -
t e r i z e d b y processing means for providing downlink
N-PDU and downlink GTP T-PDU sequence numbers along with
each N-PDU forwarded to the target support node.

5   52. The support node according to claim 50 c h a r a c -
t e r i z e d b y a buffer for buffering a set of N-PDUs
sent down to the source BSS for each packet flow subject to
lossless PS handover.

53. The support node according to claim 50 c h a r a c -
10 t e r i z e d b y processing means for including an RLC
ACK/NACK report in a PS handover command message, allowing
a mobile station to determine which one or more N-PDUs have
been completely received by the network.

54. The support node according to claim 50 c h a r a c -
15 t e r i z e d i n that a PS handover command sent from
the support node to a source BSS includes expected Receive
N-PDU sequence number, at which a mobile station should
start transmission in a target cell for each uplink packet
flow subject to lossless handover.

20 55. The support node according to claim 50 c h a r a c -
t e r i z e d b y recording means for recording uplink
and downlink G-PDU sequence numbers associated with uplink
and downlink N-PDUs while in unacknowledged mode between
the mobile station and the support node.

25 56. The support node according to claim 49 c h a r a c -
t e r i z e d i n that the base station change is within
GERAN or between GERAN and UTRAN.

57. The support node according to claim 49 c h a r a c -
t e r i z e d i n that a protocol entity of the support
30 node maintains sequence continuity over the support node.

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58. The support node according to claim 57 c h a r a c - t e r i z e d   i n   that the protocol entity operates according to SNDCP.

59. The support node according to claim 49 c h a r a c -
5   t e r i z e d   i n   that upon completion of a packet switched base station change, the support node sustaining the base station changed to starts transmissions of proto- col data units to the at least one mobile station at the next protocol data unit expected by the at least one mobile
10   station.

60. The support node according to claim 59 c h a r a c - t e r i z e d   b y   receive means, the transmissions being started upon the receive means receiving a PS Handover Com- plete message.

15   61. The support node according to any of claims 48-60 c h a r a c t e r i z e d   i n   that the protocol data units are compliant with Sub-Network Dependent Convergence Protocol.

62. The support node according to claim 61 c h a r a c -
20   t e r i z e d   b y   the processing means recording accord- ing to the Sub-Network Dependent Convergence Protocol N-PDU sequence numbers of N-PDUs received or transferred.

63. The support node according to claim 61 c h a r a c - t e r i z e d   b y   the processing means recording accord-
25   ing to the Sub-Network Dependent Convergence Protocol G-PDU sequence numbers of G-PDUs received or transferred.

64. The support node according to any of claims 61-63 c h a r a c t e r i z e d   b y   buffer means, buffering downlink N-PDUs

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65. The support node according to claim 64 charac-
terized in that the buffer size is sufficiently
large for a number of N-PDUs corresponding to a delay at-
tribute of the associated packet flow.

5   66. The support node according to any of claims 48-65
characterized in that the information on
next expected protocol data unit is transferred in a mes-
sage initiating or completing a change of base station or
handover as regards the at least one mobile station.

10   67. The support node according to claim 66 charac-
terized in that the message initiating or complet-
ing a change of base station or handover is a PS Handover
Command or PS Handover Complete message.

68. The support node according to claim 64 or 65
15   characterized in that the buffered protocol
data units are transferred upon packet switched base sta-
tion change to a support node sustaining packet switched
communications over the base station to which the at least
one mobile station changed.

20   69. The support node according to claim 68 charac-
terized in that the buffered protocol data units
are transferred upon completion of a preparation phase of
the packet switched base station change.

70. The support node according to any of claims 48-69
25   characterized in that the support not is a
Serving GPRS Support Node.

71. A base station entity in a packet switched communica-
tions network comprising at least one support node for com-
munications involving at least one mobile station, the base
30   station entity characterized by receive
means, transmit means and buffer means, the buffer means

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buffering downlink protocol data units, the buffer means being emptied of protocol data units destined for the at least one mobile station, the protocol data units being transmitted by the transmit means upon the receive means
5   receiving a command of packet switched base station change in unacknowledged mode, as regards the one mobile station, from the at least one support node.

72. The base station entity according to claim 71 c h a r a c t e r i z e d   b y   processing means for
10   deleting buffered LLC data that has not been sent to, or acknowledged by, the mobile station at the point in time when the source BSS sends the PS handover command message to the mobile station.

73. The base station entity according to claim 72
15   c h a r a c t e r i z e d   b y sending means for sending a status message back to the source support node telling it how many LLC PDUs have been deteted.

74. The base station entity according to claim 73 c h a r a c t e r i z e d   i n   that the status message
20   provides part of the one or more deleted LLC PDUs.

75. The base station entity according to claim 74 c h a r a c t e r i z e d   i n   that the status message provides the header of the one or more deleted LLC PDUs.

76. The base station entity according to claim 71
25   c h a r a c t e r i z e d   b y receive means and transmit means, the receive means receiving uplink packet data from the at least one mobile station while the buffer means be-ing emptied of protocol data units destined for the at least one mobile station.

77. A communications system c h a r a c t e r i z e d b y means for carrying out the method in any of claims 1–36.

78. A communications system c h a r a c t e r i z e d b y a plurality of mobile stations in any of claims 37–47, the mobile stations being capable of reciprocal packet switched communications.

79. A communications system c h a r a c t e r i z e d b y a plurality of support nodes in any of claims 48–70.

80. A communications system c h a r a c t e r i z e d b y a plurality of base station entities in any of claims 71–76.